

Human Resource & Payroll System for Sri Lanka Ports Authority

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Declaration

I hereby declare that this thesis was carried out by me for the degree of Master of Science / Information Technology under the guidance and supervision of Mr. Chaman Wijesiriwardana. The previous works, articles and websites, which I have made use of, are acknowledged at the respective places in the text. I assure that the present thesis, which I am submitting to the University, no Degree Diploma or Distinction has been conferred on me, either in this or in any other University.

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Date:

Acknowledgments

This thesis is based on research done for Sri Lanka Ports Authority Payroll System by studying last ten years data. To achieve this target,

I sincerely wish to thank all those who have contributed in various ways to study this research. Words can only inadequately express my deep gratitude to my Supervisor, Mr. Chaman Wijesiriwardana, Senior Lecturer in University of Moratuwa, Sri Lanka for his meticulous care, kindness and generosity. His fruitful comments and insightful suggestions have been a crucial formative influence on the present study. He has supported me in every possible way since the beginning of my research. Without his guidance and encouragement, my research would have never been successful in the present form.

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Grateful acknowledgment to the entire batch mates of MSc in IT degree program and undergraduate students of University of Moratuwa who gave their valuable feedbacks to improve the results of the research. Further, I would like to thank my office mates for the support given to me in developing the system and editing assistance to prepare this Thesis,

Abstract

Sri Lanka Ports Authority (SLPA) is one of the largest and economically important leading semi-government Organization in Sri Lanka. One of their major problems exists with managing Human Resource and making estimates which is very crucial to plan future fund allocation for Payroll and Plan Investment.

Sri Lanka Ports Authority consists of three main ports namely Colombo, Galle and Trincomalee. Work force for above ports are 9100, 380 and 420 respectively. Sri Lanka Ports Authority pays annually over 14 Billion rupees for their employees as salary, which is nearly 40% of Organization Cost.

Payroll is a sector of the management in which accuracy is required and a lapse in the data can lead to adverse effect on employee motivation and production. In this research study, it is mainly focused on Payroll Cost estimation including Loan cost of SLPA. Currently payroll cost estimation is done using manual calculating methods and it is vastly different from the actual cost in some months. Major parameter for SLPA Payroll cost fluctuation is SLPA Loans. The reason for this is new recruitments taken place by SLPA one year or three years ago. If the SLPA recruits a few hundreds of employees within one year, they are eligible for loans from the date of their appointment. This Results on the un-expected rising amount on the loan cost by several Millions. If this repetition goes on in the same manner at the time of renewal of their Loans, the cost is unbearable to SLPA in one particular month. Taking into consideration this situation, this research is mainly focused on SLPA loans cost rather than other attributes.

Therefore, this report surveys the current state of the art in relevant technologies and methods applicable in the industry.

Finally, in this project, Finance Division of Sri Lanka Ports Authority gets an opportunity to estimate their Payroll cost, few months ahead which will assist them to analyze and manage their funds. Solution methodology is proposed to tackle date of Appointment e and date of Retirement of Employees.

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1. Introduction of Payroll Cost Estimation for Sri Lanka Ports Authority

1.1 Prolegomena

Cost of monthly Payroll is one of the major estimating area which finance division concern due to the cost ratio of it. Payroll applications are heterogeneous, distributed, complex, dynamic and large which essentially requires cutting edge technology to yield the efficiencies of financial operations.

Sophisticated Payroll system can find three major areas [1].

1. Accurate Calculations
2. Data security
3. MIS module with Accurate estimation

In large organizations, cost estimation is crucial. Top management needs these analyses to optimize their funds in short and long term.

1.2 Background and Motivation

Currently SLPA has two separate systems for Payroll and HR. Payroll system is done as an In-house development by SLPA software developers in Information Systems Division and started operations in 2006.

Payroll system is managed by SLPA IS Division and OT, Tea, Meal, No pay data entry is done by relative Divisions and other all earnings, recoveries, loans, increments entered by Finance Division. Payroll processing is performed by IS Division twice a month as mid – month advance and monthly payroll process. Pay sheets, Pay slips, recovery lists, data files for external Institutes, Management Reports, EPF/ETF, Payee tax data is given by IS Division. In Addition to these, the system handles time to time Salary increases, arrears calculation, bonus payments etc.

To solve the challenge, the development of an MIS for Payroll system is vital. A payroll refers to remuneration paid to employees, and it involves many activities like payments,

deductions, loans, OT etc. The proposed MIS will help in collecting, storing, analysing, and simulating of information for the purpose of managerial decision making concerning SLPA loan cost.

The MIS for Payroll will be based on Sri Lanka Ports Authority - Colombo finance division, and hence it is important to develop MIS to enable the organization to handle the huge number of employees from a central point which is easy and accurate. Additionally, all the three ports are controlled under the leadership of one Director Board and one Chairman.

1.3 Problem of Estimating Cost for Monthly Payroll in SLPA

Current annual cost for SLPA Payroll is nearly Rs.17.5 Billion, which is nearly 40% percent of organizational cost [16]. Payroll cost distributes mainly as mentioned below

Employee Loans	-	30%
OT	-	25%
Other Allowances	-	20%
Basic Salary	-	12%
EPF/ETF	-	08%
Bonus	-	05%

These figures are taken from 2018 Payroll data. But it varies from year to year. And when considered monthly cost within a year, it varies from month to month too.

1.4 Statement of Research Problem

In this study, realistic approach has been carried out to present a method to solve the Cost estimation problem in Payroll loans of Sri Lanka Ports Authority to top management before salary process.

1.5 Aim and Objectives

1.5.1 Aim of the Study

The aim of this research project is to manage sophisticated MIS module for SLPA top management aiming estimating of the Payroll cost for future months.

1.5.2 Objectives

Besides being one of the largest employees strengthen organizations in Sri Lanka, it is crucial to get accurate estimates for future plans and handle efficiently SLPA revenue. Therefore, in this study, two main objectives are addressed as specific objectives of the study. Those are Employee's Appointment and Retirement dates and analysing of Past Loan information which Give very close estimate for future Payroll cost.

1.6 Scope of the Project

In view of the requirements of the SLPA Top Management and Finance Division, the Accurate Management Information System has been identified as one of the important applications in Future enhancing in current Payroll System. The following functions have been identified as the project scope in order to enhance an efficiently addressed MIS for Payroll Estimation.

1.6.1 Functions have been developed by the system

Newly developed system can give outputs in both Figured and Graphical representation way. User can get past periodic Payroll Cost by selecting relevant past time period as well future Payroll Cost. User can add various payroll cost attributes for his selection and system give output according to his requirement. Furthermore system provided Top management module for SLPA Top Management and Finance Division officials.

1.6.2 Identified problems that have been solved

Since 30% of SLPA payroll cost depends on employee loans and it varies vastly within the year than other payroll attributes, this research is more focused on monthly loan cost. In view of the Manual Cost estimating approach presented, following gaps identified as, to be addressed by the Proposed Cost estimating System.

- SLPA recruit employees as few personnel sometimes 500 employees for a batch in some months. After 1 year or 3 years period from the recruitment date, they are eligible to apply a New Loan.
- After one year from the Last Loan provided month, Employee is eligible to renew the loan or apply for a new loan category.
- SLPA consider Employee's date of Retirement as well prior to granting Loans.
- Other Payroll cost attributes have slight deviations throughout the year.

Therefore, by implementing this approach, it will eliminate drawbacks of current manual procedures of Payroll cost estimation in SLPA. This state-of-the-art concept which have received most attention in realistic figures eliminates Management facing problems in some months for Un-estimated Cost hikes of Payroll.

1.7 Summary

This chapter illustrates the development of the implementation-based research carried on. Chapter 01 includes the introduction and a summary with an overview of the research which emphasise the problems has been solved in Cost Estimation; Chapter 02 discusses the literature survey done based on the topic. Chapter 03 has summarized the technologies of major areas and Chapter 04 is allocated for the topic of how proposed module approaches the problem. Chapter 05 includes the design and analysis of the research. Chapter 06 covers the implementation details where Chapter 07 evaluates the methods used in implementation and the results obtained with the current manual system. Finally, Chapter 08 discusses the Conclusion and future developments for the solution.

2. Literature Review

2.1 Introduction

This section illustrates a brief review of papers published from 2011 to 2017 in how MIS resolve estimation problems in Payroll System. Revising the previous work done to explore the distinct factors and approaches of applying different models, techniques and mathematical and algorithmic methods affecting to the results, were not reaching up to MIS requirement in SLPA.

2.2 Previous Approaches for Developing MIS Module for Payroll

During last decades, number of integrated approaches have been presented by many Researchers to give the accurate figuring in MIS. None of previous researches could address clearly similar to SLPA ue. SLPA have very unique origination structure and salary calculating methods that lead to adverse effect on employee motivation and production. But findings in below articles give areas that must be concerned when the system is designed and developed. Best solution for Sri Lanka Ports Authority (SLPA) is to develop an in-house system which suits to their major problem.

Problem Classification	Reference
Key areas and Algorithms for accurate Payroll Estimation	[1] [2]
Integrated HR information with Payroll System	[3][4][5] [6] [7]
Create formulas for estimation and processing techniques	[8] [9] [10] [11] [12]
Use of Rapid miner	[13] [14] [15]

Table 2-1 Overview Reviews of Literature Survey on Port Operations

2.2.1 Key areas and Algorithms for accurate Payroll Estimation

Alexander [1] presented the trend of increased accessibility and remote capabilities to make it easy for accounting professionals to offer payroll services. Thomson Reuters' Tax & Accounting business has released my Pay Solutions mobile application to provide employees with mobile access to payroll information. Accountants World launched its Payroll Relief mobile application in 2011 and processes more than 20,000 employer payrolls since then. But in this article, they fail to discuss how important that their data for management applies when making decisions.

P. Iancu et al [2] discussed about an overview of a new integrated information system for the management of large organizations as universities, dealing with payroll and human resources management. It is designed for specialized units or complex profile organizations, including group architecture. In particular here is presented the implementation in University Poly technics of Bucharest. Updated legislation and economic-financial practices specify how the economic/academic environments are implemented. The system offers users to multiple tools to design, configure and monitor payroll and human resources processes to ensure state-of-art management. They don't show how to get a cost estimation according to annual payment pattern and how to build relationship between HR and Payroll system

2.2.2 Integrated HR information with Payroll System

E. Saez, M. Matsaganis, and P. Tsakloglou [3] demonstrated how to respond cost of payroll that varies among annual seasons and festivals. They used cohort-based reform in Greece manipulate their outputs. At the same time, they estimated the long-term labour supply that effects an incidence of payroll tax rates on earnings. This article discusses various possible explanations for those results.

Parimalendu, J. Chowdhury, and G. Hazra [4] this article talks about Human Resources Management and how it deals with the facilities. This integrated system is designed to help provide information and requirements of Human Workforce availing and need the use in HR decision making such as administration, payroll for their working process and carrier growth. It is used to act as recruiting, training, and performance analysis. Most of contents in this article are relevant to proposed system.

K. Vikas [5] explained about keeping large data volume in more structured way. It is very important to a work place like SLPA which has over 9000 employees. But he is not much concerned about cost estimation techniques and payroll side. On the other hand, above article talks about security, software platforms, hardware etc.

S. Shiri [6] showed the attempts to identify the effectiveness and the importance of the use of HRIS on the HR functions of an organization. It includes the top management, Managers, and executive of HR working in manufacturing, service and IT sectors.

2.2.3 Create formula for estimation and processing techniques

Yang Agita Rindri, Ridi Ferdiana, Rudy Hartanto [8] has illustrated some formulas that can get payroll estimates for future months. Also, he nominated important key areas that must be considered.

Jela Abasova ; Jan Janosik ; Veronika Simoncicova ; Pavol Tanuska [9] mentioned about effective processing techniques they have discovered with Payroll data. Those techniques were very useful to create a batch process for monthly data summarizing.

Kurt Newman, Debashis Ghosh, Robert Wohlers [10] have innovated prediction and indexing mechanism which they have used in their Payroll cost estimation.

Shraddha Dwivedi ; Paridhi Kasliwal ; Suryakant Soni [11] explained comprehensive study of data analytical tools which can be used to analyse large data.

Lei Zhuang ; Jiantian Zheng [12] talked about design and implementation of accurate payroll estimation module and risk factors have to be considered in implementation.

2.2.4 Usage of Data Mining Tools/Techniques

A. Jovic ; K. Brkic ; N. Bogunovic [13] described use and characteristics of Data mining tools. It shows pros and cons of each tool and helped to select most suitable data mining tool.

Anna Lisa Gentile, Sabrina Kirstein, Heiko Paulheim, Christian Bizer [14] showed data search and integration capability of Rapid Miner. They also discussed about other data mining tools and user friendliness of Rapid miner.

Marcin Blachnik, Mirosław Kordos [15] showed data selection and data compression methods that can be used in Rapid miner.

The method used to solve various problems and give realistic estimates regarding payroll cost is an interesting one, authors are able to reduce the gap between estimated and actual figures. The method they proposed is more understandable for the readers hence the accuracy of the results is acceptable. Therefore, this paper can be rated as highly acceptable to solve cost estimation problem in a Sri Lanka Ports Authority Payroll system which they haven't mentioned about constraints and the assumptions in their paper.

2.3 Discussion of Previous Approaches

This summarized report discusses about the reviewed literature on Cost estimation in Payroll System. Researchers mainly pointed their models and algorithms and introduced methods based on optimizing the Estimation with realistic. Accordingly, discussion of the reviews are categorized as follows,

2.3.1 Key areas and Algorithms for accurate Payroll Estimation

Reviewing papers listed as [1] and [3], this type of models can be considered as productive models for accurate forecasting methods of Payroll System to cope up with minimizing over estimating and under estimating. Therefore, this type of Researchers must be motivated since accurate cost estimation of large organization is a key factor in decision making. Finally, this nature of papers can be chosen as inventions providers for developing of new scenario for Payroll Estimation problems.

2.3.2 Integrated HR information with Payroll System

By considering the papers reviewed on this study of research, it has been observed that many Researchers are presented their solutions as integrated optimization for multiple resources. With these integrated solutions, comparing with the papers discussed above [3 ~ 6], the approach presented by E. Saez, M. Matsaganis, and P. Tsakloglou et al. [3] is more or less equal compared with the paper [2] reviewed in this report and these models could be efficiently used for a proposed MIS module.

2.4 Identified Gaps between Past and Present Approaches

Although there are many achievements obtained by introducing interactive tools for MIS and Payroll Estimation in recent past, most of the important rules and constraints are not incorporated equal to SLPA Case study. Therefore, it still exists the gap between implemented models and the practical usage of Payroll Estimation.

- Since the SLPA practise is very unique for its own, these approaches are not applicable.
- As a government organization, SLPA change it's policies and rules from time to time.

Therefore, a new approach and a method required to solve the SLPA Payroll Cost Estimation problem.

2.5 Summary

Previous Researchers have developed wide range of Payroll systems but most of them were not reaching up to MIS stage. Best solution for Sri Lanka Ports Authority (SLPA) is to develop an in-house system which can suit for their major problem. Currently SLPA has a big issue with making estimates before Payroll payment. But unfortunately, none of the previous Researches could address clearly for SLPA case. SLPA has a very unique origination structure and salary calculating method that leads to adverse effect on employee motivation and production. But, findings in above articles must be concerned when the system is designed and developed which is illustrated in the next chapter.

3. Approach

3.1 Introduction

This chapter is focused on the selected approach and the way the technology is adapted in terms of its users, inputs, outputs, process and constraints applicable to provide a solution for MIS of HR and Payroll system for SLPA.

3.2 MIS module of HR and Payroll system

To solve the providing accurate MIS module for HR and Payroll system of SLPA, web-based application has been developed to retrieve data from the existing Payroll and HR system of SLPA and it facilitates the Finance division officials and top management of SLPA to get a clear idea regarding organization's future expenses. It helps to control the cash flow and make the Investment plan for next few months. System user can get an estimation report for next few months. The system facilitates user to take the output as graphical representation or as figures.

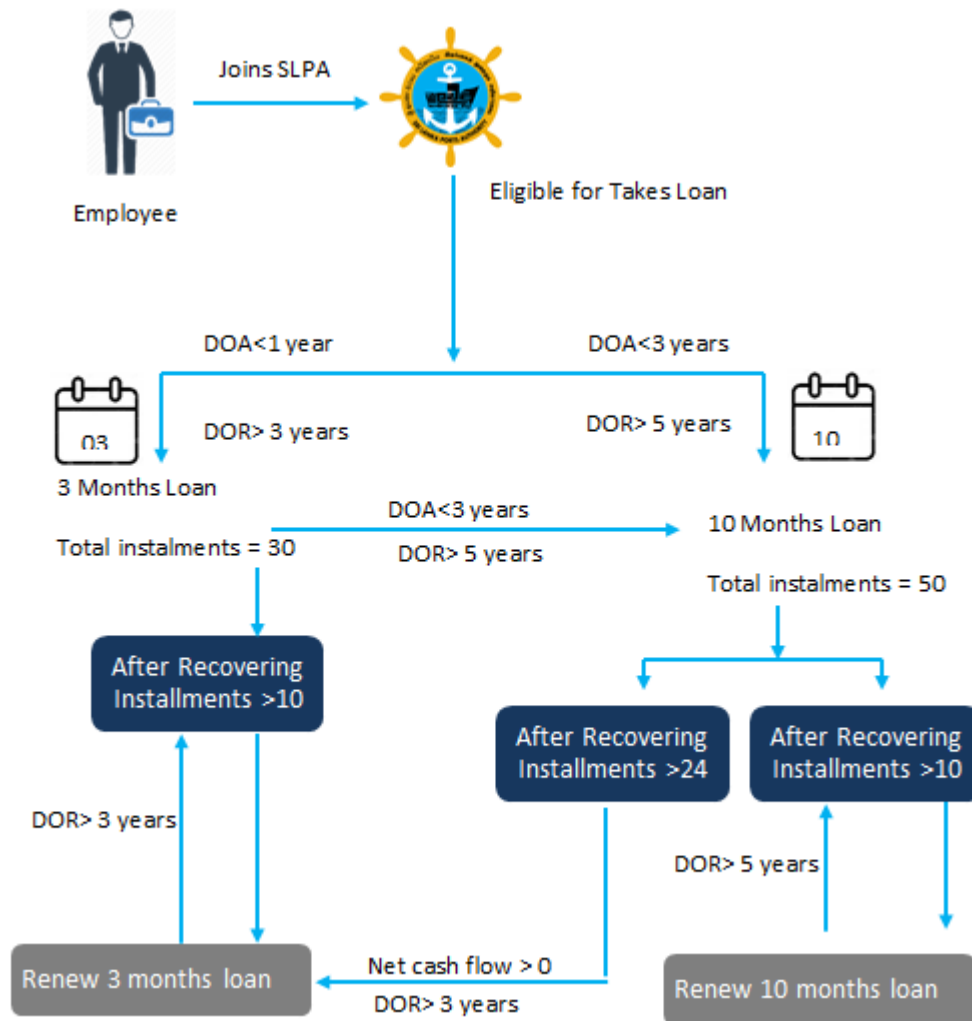
Following steps are considered as the outline of MIS module of HR and Payroll system.

- Transfer Employee Master file data from Payroll System
- Transfer monthly processed Payroll data from Payroll System
- Calculate estimates according to user request
- Any other constraints applicable for the process

3.3 Outline of MIS module of HR and Payroll system

Following processes have been identified as the outline of MIS module of HR and Payroll system.

- Develop user interfaces for each categories of users to enter the time period for prediction
- Batch process for transfer Payroll data to MIS module
- Calculate estimated Loan cost and other payroll costs for the given period
- Give out puts for the given period as Graphical or Numeric values as per user request.



- * $\text{Loan Capital} = (\text{Basic Salary} + \text{Port Allowances} + \text{Professional Allowance}) * \text{Months of Loan type}$
- * $\text{Net cash flow to employee} = \text{Loan Capital} - \text{Due Amount from previous loan}$
- * DOA= Date of Appointment
- * DOR= Date of Retirement

Figure 3.-1 Sri Lanka Port Authority Monthly Loan Eligibility Criteria

3.4 The main stakeholders of the system

The system collaborate with four active actors in one cooperate system. Following user roles are available in the system.

- Administrator
- Top Management
- Finance Division Higher Officers
- Cash & Investment Managers

According to the System, functions of the User roles can be categorized as follows,

Administrator:

- Secure login to the system
- User Management
- Transfer Payroll Data
- View/Generate summary report

Top Management

- Secure login to the system
- View estimated cost for a given time Period as numeric value
- View estimated cost for a given time Period as Graphical representation
- View/Generate summary report

Finance Division Higher Officers

- Secure login to the system
- View estimated cost for a given time Period as numeric value
- View estimated cost for a given time Period as Graphical representation
- View/Generate summary report

Cash & Investment Managers

- Secure login to the system
- View estimated cost for a given time Period as numeric value
- View estimated cost for a given time Period as Graphical representation
- View/Generate summary report

3.5 Process

After monthly payroll process, batch process is scheduled to run and transfer Processed payroll data to MIS module. Based on Payroll data and Employee master file data, MIS module does the calculations and provide required output for the given time period by the user.

3.6 Summary

This chapter described how to adopt the technology for the approach of MIS module of HR and Payroll system. Our approach is mainly based on the web-based application. It gives the opportunity to get more precise future cost estimation and how it verifies by months. System able to consider all conditions when it forecast for future cost. Next chapter describes about the analysis design and of the solution.

4. Analysis and Design

4.1 Introduction

The Approach of the solution for the problem domain has been described in the previous chapter. In this chapter, detailed description of the system is analysed and described by analysing each module of the system. Further, high-level system design diagrams are included to provide the description of the process clearly.

4.2 Phases of the System

The solution is designed in two separate phases and integrates the implementation. The two phases are,

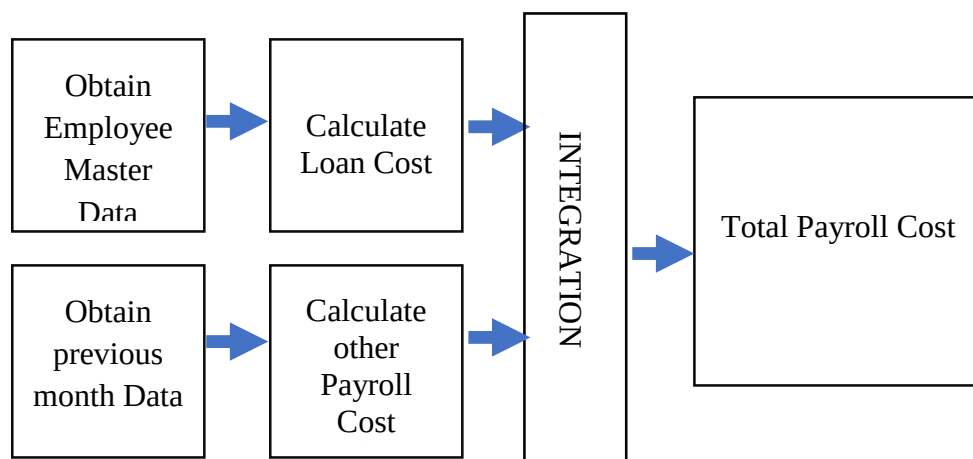


Figure 4.-1High Level Design of the Solution

4.3 Use Case Diagrams of main actors of the system

Graphical representative of the main actors are shown as below:

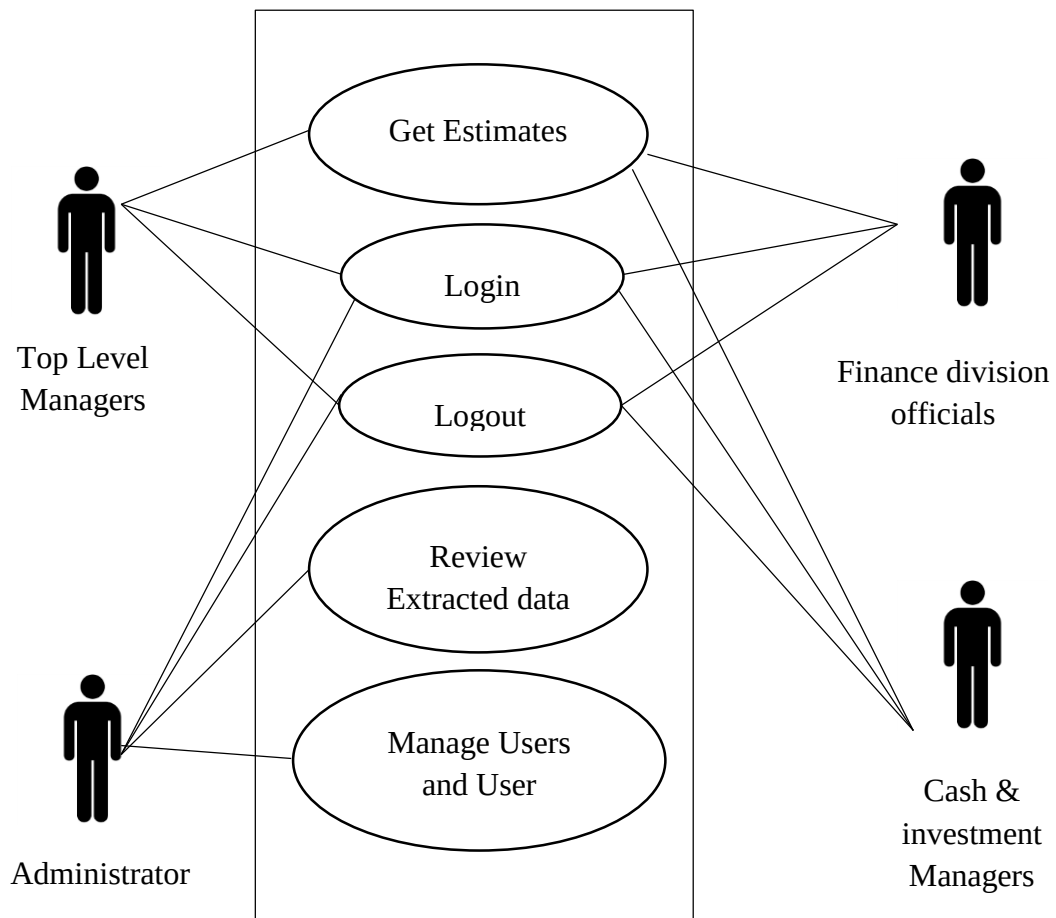


Figure 4.-2Use Case Diagram of the System

As illustrated on the Figure 5.2 – Use Case Diagram of the System, detailed description of user roles are as follows,

4.3.1 Use Case of Top-Level Management

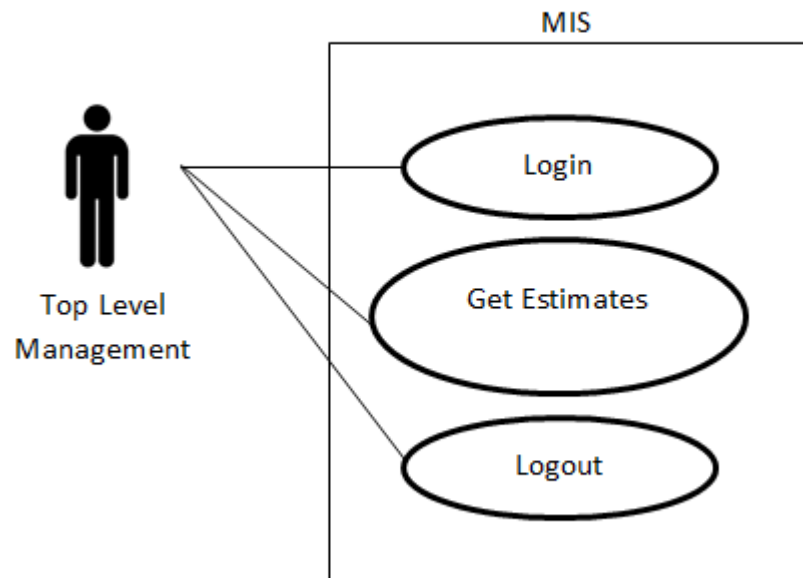


Figure 4.-3Top Level Management

- Use case: Get Estimates

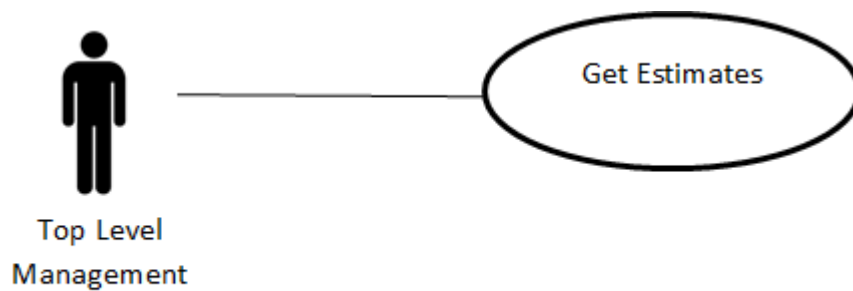


Figure 4.-4Get Estimates

Brief Description:

The Top level Manager accesses the MIS module, fill the required time period for estimating and way of the output he needs (Graphical or Numeric figured).

Initial Step-By-Step Description:

Before initiating this use case, the Top level Manager has to browse the online web application

- Top level Manager Login to the system by entering user name and password.
- The system displays the correct form.
- The Top level Manager enters the estimating period and the way he needs the Output (Graphical or Numeric figured).

4.3.2 Use Case of Finance Division High Officers

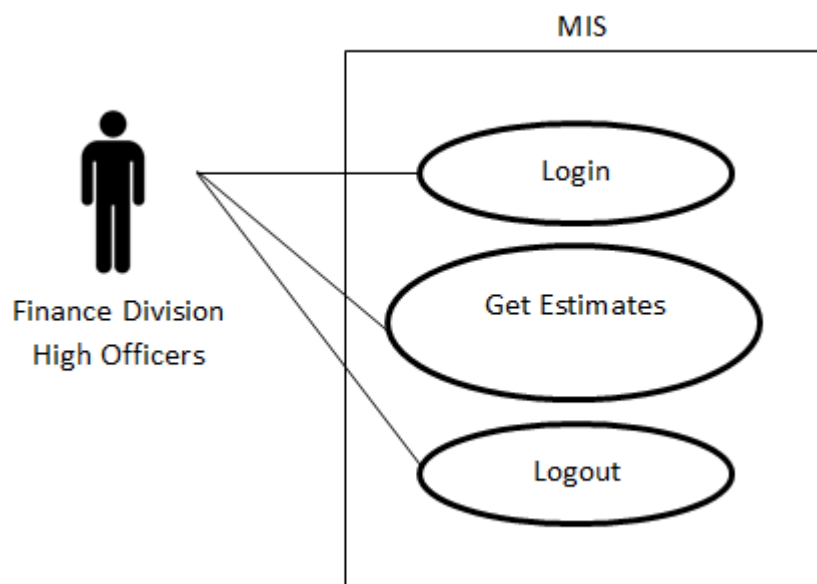


Figure 4.-5Finance Division High Officers

- Use case: Get Estimates

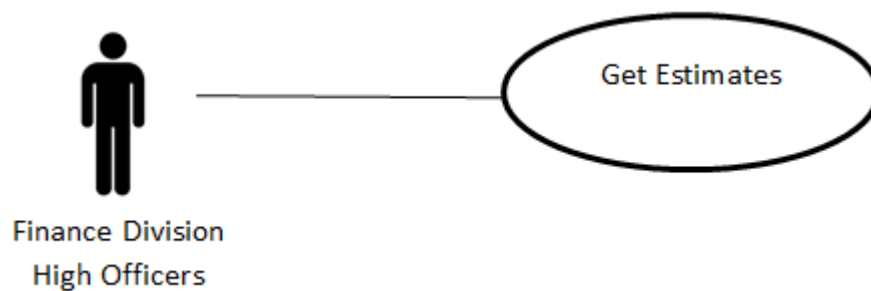


Figure 4.-6 Get Estimates

Brief Description:

The Finance Division High Officer accesses the MIS module, fill the required time period for estimating and way of the output he needs (Graphical or Numeric figured).

Initial Step-By-Step Description:

Before initiating this use case, the Finance Division High Officer has to browse the online web application

- Finance Division High Officer Login to the system by entering user name and password.
- The system displays the correct form.
- The Finance Division High Officer enters the estimating period and the way he needs the Output (Graphical or Numeric figured).

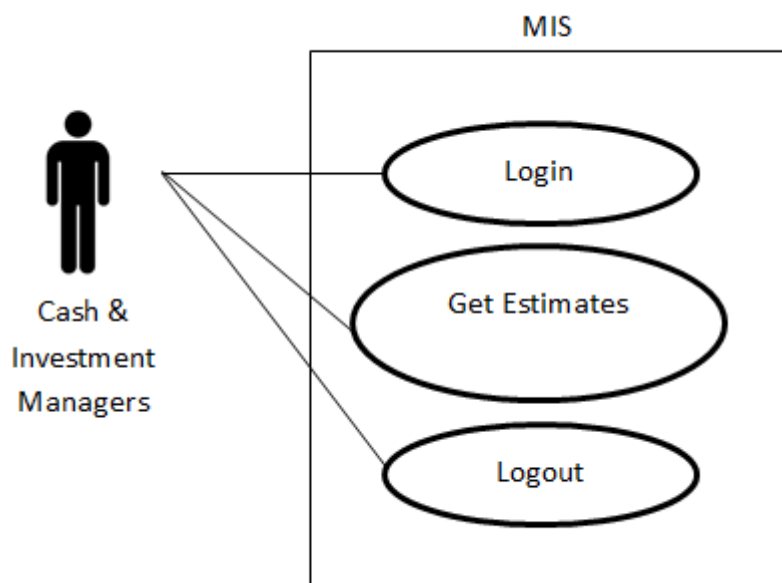
4.3.3 Use Case of Cash & Investment Managers

Figure 4.-7Cash & Investment Managers

- Use case: Get Estimates



Figure 4.-8 Get Estimates

Brief Description:

The Cash & Investment Manager accesses the MIS module, fill the required time period for estimating and way of the output he needs (Graphical or Numeric figured).

Initial Step-By-Step Description:

Before initiating this use case, the Cash & Investment Manager has to browse the online web application

- Cash & Investment Manager Login to the system by entering user name and password.
- The system displays the correct form.
- The Cash & Investment Manager enters the estimating period and the way he needs the Output (Graphical or Numeric figured).

4.3.4 Use Case of Administrator

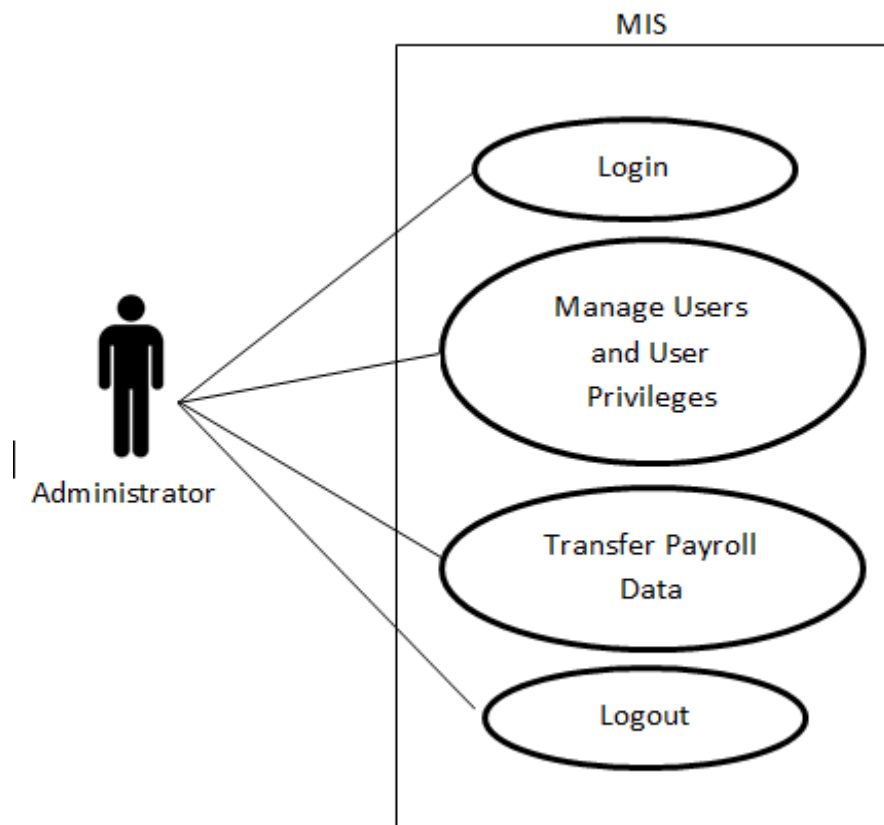


Figure 4.-9 Administrator

- Use case: **Manage Users and User Privileges**

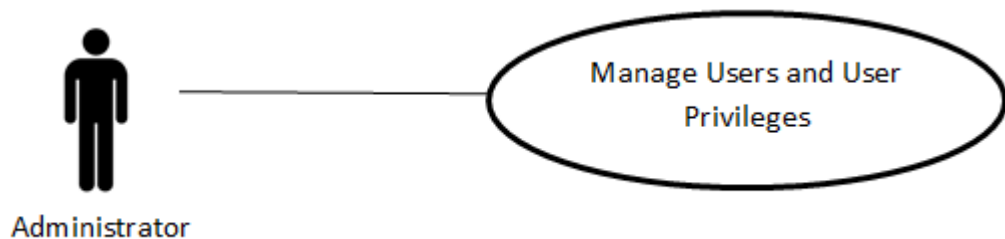


Figure 4.-10 Manage Users and User Privileges

Brief Description:

The Administrator accesses the MIS module, Create user and assign privileges according to user requirement

Initial Step-By-Step Description:

Before initiating this use case, the Administrator has to browse the online web application

- Administrator Login to the system by entering user name and password.
- The system displays the correct form.
- The Administrator enter User's 'user id', 'password' equal to 'user is' and privilege group particular user belongs

- **Use case: Transfer Payroll Data**

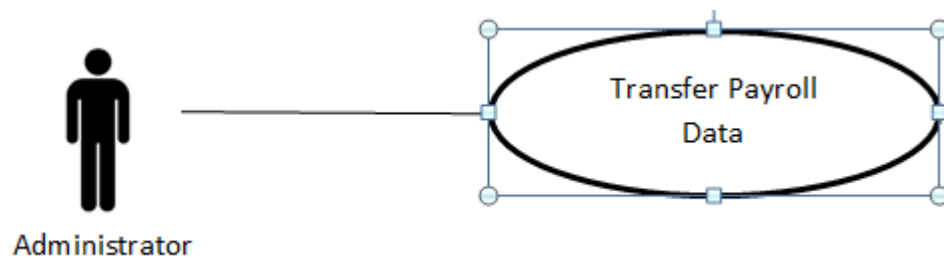


Figure 4.-11Transfer Payroll Data

Brief Description:

The Administrator accesses the MIS module and triggers a batch process which extracts Payroll data from Payroll system, convert it according to MIS system file format and upload to MIS module.

Initial Step-By-Step Description:

Before initiating this use case, the Administrator has to be browse the online web application

- Administrator Login to the system by entering user name and password.
- The system displays the correct form.
- The Administrator runs the Batch process from Administrator console in MIS Module.

- System extracts required data from existing payroll database runs on Oracle 9i, re-arrange according to MIS Data file formats and uploads to MIS Database in MY SQL.

4.4 Design Diagrams of the system

All other relevant diagrams of analyzed the requirements, designed processors and user interfaces of web base application development included in Appendix A. Accordingly, the application has been developed to interact with the system users.

4.5 Summary

This chapter shows the designing and analysing part of the application. There are four main modules in the system which are

- Extract and Transfer Payroll data module,
- Calculate estimates module,
- Report generating module and User Controlling module.
- Implementation of the solution in detail.

5. Implementation

5.1 Introduction

Implementation is the most critical and important stage of MIS development. This chapter describes how the MIS developed and implemented on SLPA payroll. During MIS implementation, it is focused on developed methodologies and techniques, installing the software and configuring the capabilities of the software. Considering the complexity and volume of Payroll system, series of activities were used to find realistic output. Therefore, to implement this system more attractive and efficient, few tools, technologies were used. The details of the implementation environment, hardware infrastructure, development strategies, tools used, database and the Application development architecture are described in this chapter.

5.2 Implementation Environment

Web based application is developed as a solution for the Cost Estimation problem and to provide interfaces for both Finance Division and Top Management users of SLPA. Hardware infrastructure basically divided into two categories as Server and Client environment.

5.2.1 Server Environment

Since the solution is based on web based development with centralised client server architecture, identified minimum hardware and software requirement for hosting the server side applications are listed below:

- Intel Core I7 processor
- RAM 16GB
- 1TB HDD
- Network speed 1Gb Ethernet
- Window Server 2016 with IIS 8
- C# version 5
- My SQL 5.7

5.2.2 Client Environment

Minimum Hardware and Software configuration required to access the system are listed as follows,

- Intel Core I3 Processor
- 8 GB RAM
- 500 MB HDD
- Network access and card support 100Mbps
- Windows 10 OS 64bit
- Latest version of Firefox
- Latest version of Chrome

5.3 Technology and Development tools used for the solution

To develop a web-based solution for New MIS Module for SLPA Payroll System, following technologies and the tools were used.

5.3.1 Technologies

- **C# Language:**

C# version 5 is used to develop the applications, since C# is multi paradigm Programming Language and run on .Net frame work. C# is a server-side scripting language designed for Web development.

- **Joomla Framework:**

The system is based on Joomla Core framework. Joomla component development architecture compile with Model View Controller (MVC). This gives more dynamic architecture to development the system. Based on Joomla core the system has been used the legacy Object Relational Mapping (ORM) on Joomla when doing the DB queries. Also, Joomla framework has been utilized to session handling and log file maintenance.

- **Rapid Miner:**

Rapid Miner is a data mining tool that can be used to analyse data more scientifically. It is a machine learning software and system can forecast with realistic values for future period. Furthermore, Rapid Miner supports for most

of data formats and data bases and able to give outputs as graphically or figures.

5.3.2 Development tools

- **Sublime:**

Sublime text 3 was used as the Integrated Development Environment (IDE) for this project. Sublime text is one of the most popular code editors available today and it is adored by many Programmers for it's speed, simplicity and rich plug in ecosystem. Sublime has been installed with all syntax checker features and this gives developer friendly environment.

- **Apache:**

Apache is the most widely used web server software and Apache 2 was used as the web server of this project. Apache is an open source freely available software which is a fast, reliable and secure. It can be highly customized to meet the needs of many different environments by using extensions and modules.

- **MySQL:**

MySQL is an Oracle-backed open source Relational Database Management System (RDBMS) based on Structured Query Language (SQL). MySQL runs on virtually all platforms, including Linux, UNIX and Windows. Although it can be used in a wide range of applications, MySQL is more often associated with web applications and online publishing.

MySQL is based on a client-server model. The core of MySQL is MySQL server, which handles all of the database instructions (or commands). MySQL server is available as a separate program for use in a client-server networked environment and as a library that can be embedded (or linked) into separate applications.

- **Php Myadmin:**

This is an open source tool to query the database values and execute SQL statements.

- **Web browsers debug tools:**

Firefox and Chrome developer tools are used in the implementation process. These tools provide many debugging features of error handling when the issues arrive at the system.

5.4 Application Development Architecture

The system was developed using Model View Controller (MVC) architecture. This includes the module-based development which is a software design pattern for developing software applications.

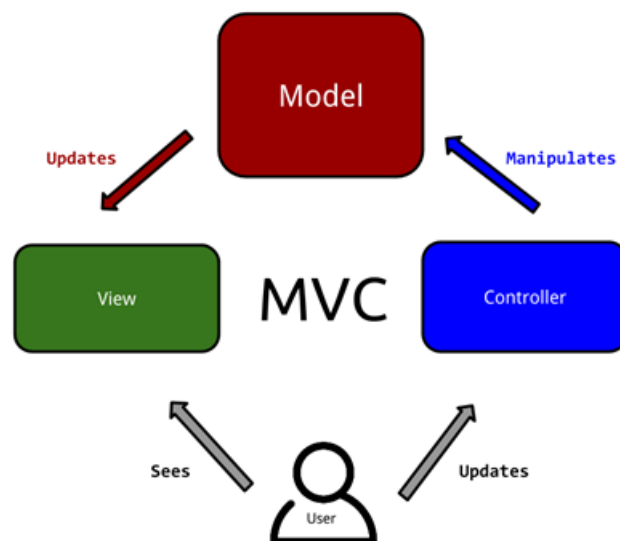


Figure 5.-1 MVC Architecture

Model: The model is responsible for managing the data of the application. It responds to the request from the view and it also responds to instructions from the controller to update itself. [6]

Controller: The controller is responsible for responding to the user input and perform interactions on the data model objects. The controller receives the input, it validates the

input and then performs the business operation that modifies the state of the data model. [6]

View: It means presentation of data in a particular format, triggered by a controller's decision to present the data. They are script-based templating systems like JSP, ASP, PHP and very easy to integrate with AJAX technology. [6]

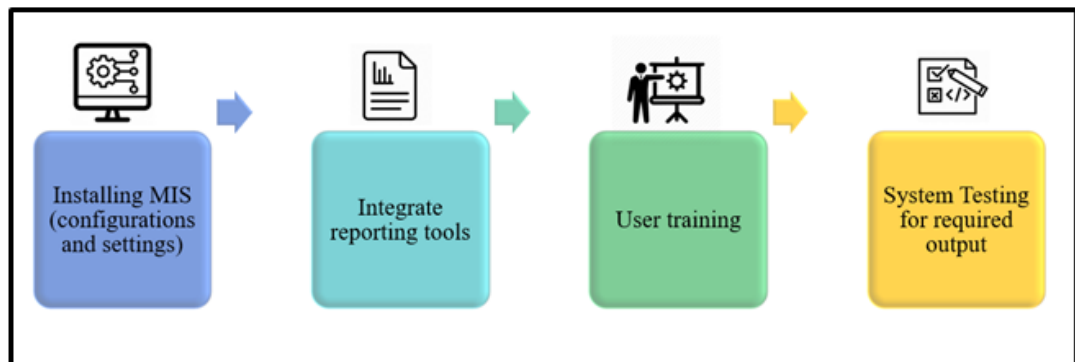
5.5 Implementation of Application Software

Implementation of application software is another critical and important stage of MIS development. Following sections describes how the MIS implemented on SLPA. During MIS implementation, it is focused on installing the software and configuring the capabilities of the software.

Implementation of Application Software mainly follows under two categories.

- Implementation of Software
- Implementation of user modules

Implementation process has four major phases.



5.5.1 Installing MIS (configuration and settings)

Six people from top managerial level and six Finance Division officials are responsible for decision making to use MIS. Currently they are using SLPA payroll system on their PCs. When the developments over MIS module is attached to the existing payroll system, it gives accessing facilities to above professionals.

Regularly, there are three Payroll processes taking place monthly for three ports. After processing the payroll, processed data is uploaded to MIS Database through a batch process. Batch process mainly consists of main four parts. Following figure illustrates the steps of the batch process.

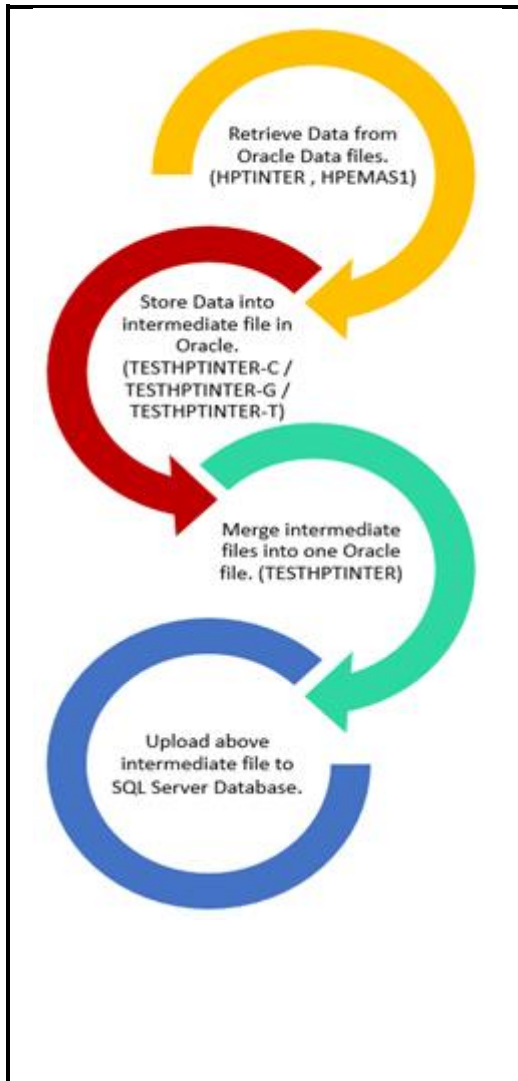


Figure 5.-2 Batch processing

```

CONNECT US01/US01@CLHRM

SPOOL C:\TESTHPTINTER.lst

INSERT INTO TESTHPTINTER-C (PORTID, SCALENO,
PAYCODE, AMOUNT, UNITS, NOOFREC, YEAR,
MONTH)

SELECT
NVL(e.PORTID,0),
NVL(e.MSCALE,0) AS SCALENO,
NVL(h.TWCODE,0) AS PAYCODE, SUM(h.TWAMT) as
AMOUNT ,
SUM(h.TWVALUE) as UNITS,
COUNT(e.MEMPNO) AS NOOFREC,
CAST((SELECT EXTRACT(YEAR FROM SYSDATE)
FROM DUAL) AS INT) AS YEAR,
CAST((SELECT EXTRACT(MONTH FROM SYSDATE)
FROM DUAL) AS INT) AS MONTH
FROM HPTINTER h INNER JOIN HPEMAS1 e ON
h.TWEMPNO = e.MEMPNO
GROUP BY e.PORTID, e.MSCALE, h.TWCODE;

SPOOL OFF

EXIT;
  
```

Figure 5.-3 SQL script for data retrieval and insertion

Retrieving and inserting data to Oracle file is trigger by a 'TESTHPTINTER.bat' file. Above bat file call a SQL script. After data preparation is over, pre-process is done as well before entering to report integration stage. There appends a result of a Batch process and records to SQL server file. (TESTHPTINTER).

PORTID	SCALENO	PAYCODE	AMOUNT	UNITS	NO OF REC	YEAR	MONTH
C	011	005	497500	0	10	2018	02
C	011	005	497500	0	10	2018	01
C	011	005	497500	0	10	2018	03
C	011	008	15432.69	0	1	2018	01
C	011	015	24516.35	0	1	2018	01
C	011	055	11076.92	0	1	2018	02
C	011	055	2692.31	0	1	2018	01
C	011	090	9000	0	2	2018	03
C	011	090	5000	0	1	2018	01
C	011	101	112500	0	3	2018	03
C	011	101	112500	0	3	2018	01
C	011	101	112500	0	3	2018	02
T	112	088	68958.4	884.05	5	2018	01
C	061	088	17950665	103532.3	346	2018	02
C	062	088	8724681	52086.6	138	2018	02
C	063	088	12860854	86073.95	321	2018	02

Table 5-1SQL Server Data file-TESTHPTINTER

Above data set is taken to make predictions and estimations using Weka. This data can have in-complete, noisy and inconsistency data. Weka will do cleaning, integration, transformation, reduction and discretisation and start data mining.

5.5.2 Integrate Reporting Tools

After updating data set by Rapid Miner, Power BI will give outputs graphically and reports required.

5.6 Implementation of user modules

Four modules are developed in the system namely,

- Data extracting module from current on-going Payroll System,
- Finance Division module,
- Top Management module
- Administrator module.

The integrated system is developed by implementing and integrating every module of use cases.

5.6.1 Data extracting module

Main functionalities of the Data extracting module from current on-going Payroll System are as follows. The use case and activity diagrams related to the functionalities of this module are included in Chapter 5 from figure 5.7 to figure 5.12.

- **Login**

In this use case System Administrator can log in to the system.

- **Review Extracted Data**

When the System, Administrator extract and upload Payroll Data to MIS module the System Administrator must review the transferred data in to the system

- **Logout**

In this use case System, Administrator can logout in the same manner.

5.6.2 Finance Division Module

In the Finance Division module following functions are facilitated.

- **Login**

In this use case Finance Division officials can log in to the system.

- **Get Estimates**

When the Finance Division officials (Such as Director Finance, Chief Finance Manager, Deputy Chief Finance Managers and Cash & Investment Managers) can get graphical or numeric valued reports for a required period.

- **Logout**

In this use case Finance Division officials can logout in the same manner.

5.6.3 Top Management Module

In this module following functions are facilitated.

- **Login**

In this use case Top Management Officers such as Chairman, Vice Chairman, Managing Director, Executive Directors can log in to the system.

- **Get Estimates**

After login to the System by Top Management officials, they can get graphical or numeric valued reports for required period.

- **Logout**

In this use Top Management Officers can logout in the same manner.

5.6.4 Administrator Module

In Administrator Module, following functions are facilitated.

- **Login**

In this use case System Administrator can log in to the system.

- **User Control**

The admin module controls all the login parties of the system.

- **Logout**

In this use System Administrator can logout in the same manner.

5.7 Summary

The implementation chapter depicts how hardware infrastructure, software, technologies and tools used to develop and implement and the functionalities described under each use case. Each module has an interconnection with the system to give a better output to the user. The technology and tools described are widely used to develop similar complex systems. To develop MIS which are limited and most vital in fund allocating, a model of realistic approached system has been developed for SLPA to manage the key issue in decision making. To manage the cost of future months SLPA loans, the approaches used to evaluation of the proposed solution been illustrated in the next chapter.

6. Evaluation

6.1 Introduction

In this chapter it portrays the clear view of MIS (Managing Information System) and system tested with past few years' data. Initially functionality of the developed system is tested and then mainly focused on the accuracy of the results. The test results analyzed using descriptive statistics. There the co-relations between actual data and predicted data is used to substantiate the accuracy of the system.

6.2 Functionality testing of MIS application

Activity	Procedure	Expected Output	Results
User Registration	Enter user registration details.	Displays successful message.	Achieved.
	Incompletely registration details filling.	Notify required fields.	Achieved.
	Enter details of existing user.	Displays error message	Achieved.
User Login	Enter correct user name and password	Direct to the home page	Achieved.
	Enter incorrect user name and password	Displays Login failed error message	Achieved.
	Not enter correct user name	Displays Login failed error message	Achieved.
	Not enter correct password	Displays Login failed error message	Achieved.
Input Cost of Living	Enter monthly cost of living amount and press submit button	Display prediction result for the month	Achieved.

Table 6-1

6.3 Evaluation of the accuracy of predicted data

Using statistics and the evaluation of the system is done. The ultimate goal is ascertaining accuracy of the predicted data. To perceive the research results, a study model was developed using independent and depend variables. An independent variable is a factor that functioning or stand-up on its own. It is not exaggerated by other factors. Depend variable is a factor that is affected by other factors, mostly on independent variables. In this particular study two variables were identified. Following diagram illustrates the study model and relationship between identified variables.

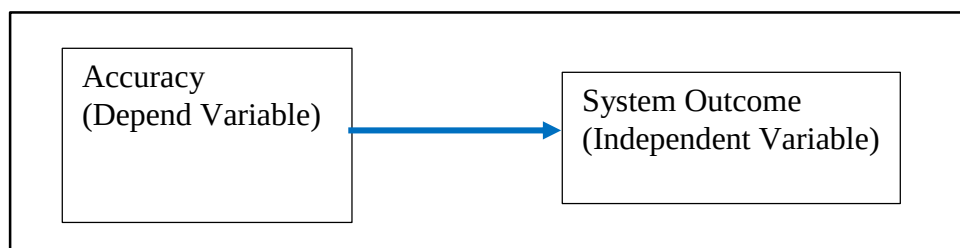


Figure 6.-1Study model

Based on the study model a hypothesis is established. Simply a hypothesis is analyzing evidences to suppose or oppose particular idea that has not yet been proved. In this research the expected outcome is an accurate solution to forecast loan amount for SLPA Payroll. The hypothesis is developed by exploring the nature of relationship between accuracy (depend variable) and system outcome (independent variable).

H0: The system is accurate to forecasted payroll cost.

H1: The system is not accurate to forecasted payroll coast.

Hence the hypothesis develops the latter part of the paragraph focused on data analyze for testing hypothesis, from 2010-2019 (10 years) the Payroll data collects and mean values calculates year wise and month wise. Mean represents average value for a group of data. It eases the complexity of analyzing large amount of data. Below tables exemplifies the mean values of loan data from past ten years while line graphs displaying inter relationships between predicted and actual Payroll cost.

Year	Mean value of actual data	Mean value of Predicted data
2019	59497932	63304471
2018	53073064	61304471
2017	55418742	60651383
2016	43491557	50526585
2015	52961109	56808507
2014	51932461	57923074
2013	52443572	58444877
2012	53121806	62372029
2011	52776128	61193463
2010	52887239	60136357

Table 6-2 Annual data

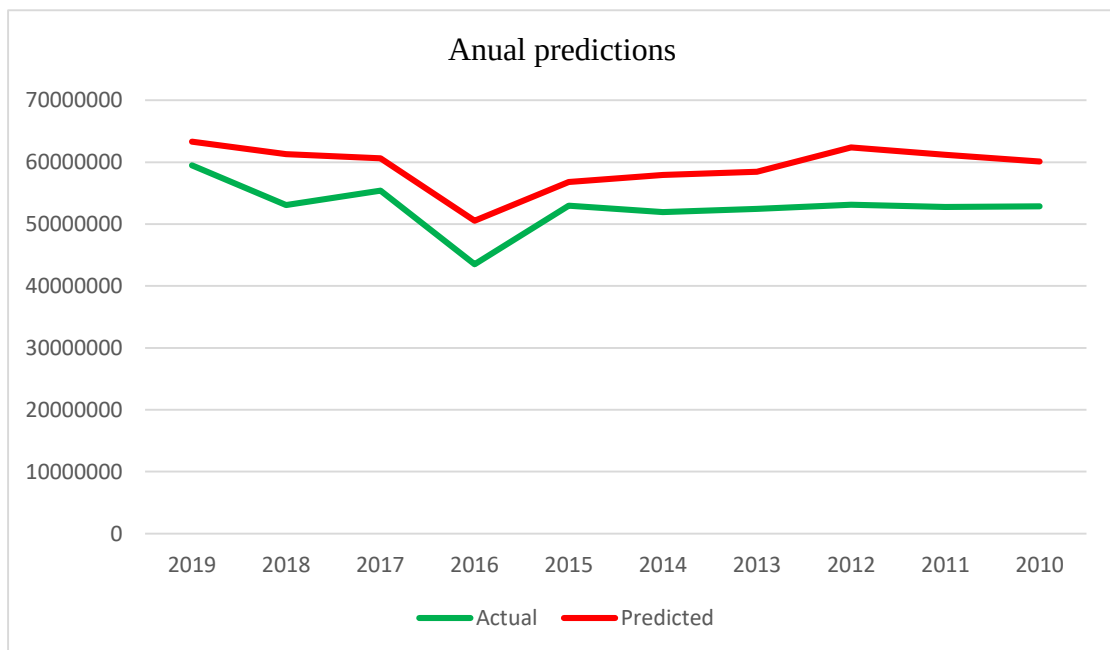


Figure 6.-2Annual fluctuations of data

Above graphical illustration displays how actual and predicted data differ by year. It is almost horizontal to each other. To understand variations of actual and predicted data in depth, a month wise analysis was done deeply. It is explained further in this chapter.

Month	Mean value of actual data	Mean value of Predicted data
JAN	48817628	53888501
FEB	46802856	50600274
MAR	46396355	60028094
APR	52056585	55757459
MAY	50558245	56459139
JUNE	55395784	60259701
JULY	51660008	61259476
AUG	53959006	55659876
SEP	53259009	60062552
OCT	54359009	61659878
NOV	56695285	60699050
DEC	63164562	72464337

Figure 6.-3 Monthly mean values

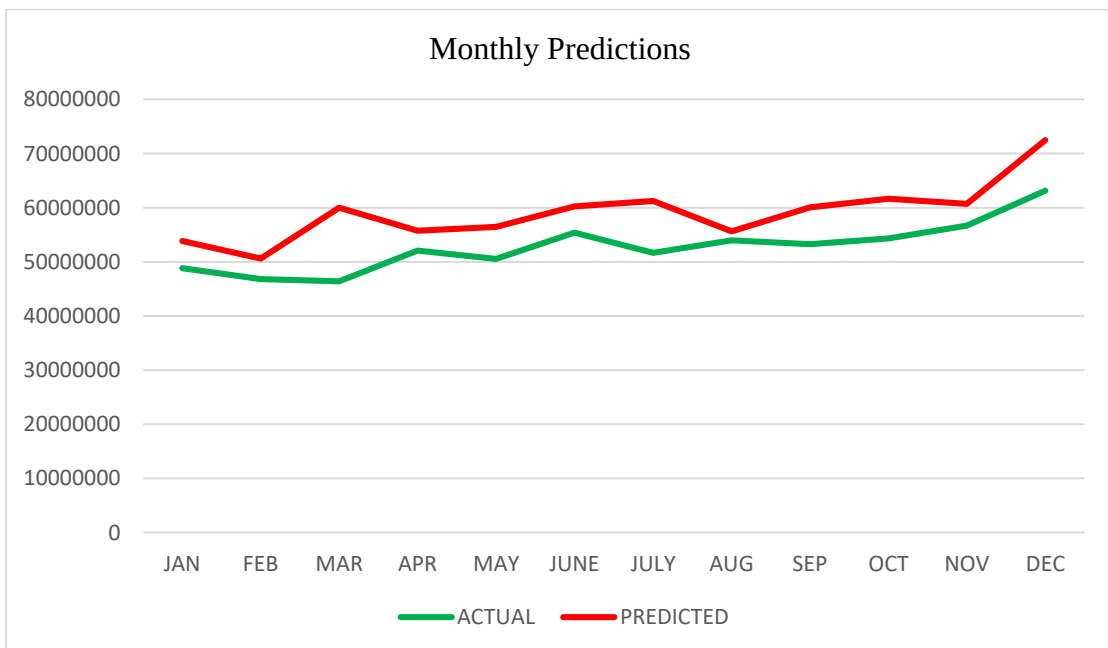


Figure 6.-4 Monthly fluctuation of loan data

The monthly fluctuations of payroll data graph illustrate how mean values of actual and predicted data alteration according to month. In January, actual and predicted values go parallel with a slight difference by increasing the value of predicted data. February predicted value is lesser but higher than actual data when compared with January. Significantly in March, the actual loan amount decreases while the predicted value increases. The practical scenario behind the case is, the amount of loan applicants decreases at the time of employee's retirement. The retirement has huge impact to the employee population. When it comes to April, the number of actual loan amount increases resulting high payroll cost but predicted loan amount remains steady to a certain extent until June with payroll cost. In July, there is a diminutive drop of actual payroll cost due to lack of loans. Though there is a drastic drop of predicted value in August, actual loan amount is faintly lesser than the predicted value. From September to November, there is an increase of actual loan amount with the little increase of predicted value showing the effect to Payroll cost. In December there is an escalation of both actual and predicted values. Overall, the graph illustrates that there is a trivial alteration between actual and predicted values. Hence, there is a high exactitude of output results.

To confirm above result a statistic analysis was driven. At the initial step correlation between actual values and predicted values was calculated. According to Pearson, the correlation coefficient (r) is a measure of the linear association of two variables. Correlation analysis usually starts with a graphical representation in relation to the data pairs using a scatter diagram. The values of correlation and coefficient vary from -1 to $+1$. Positive values of correlation coefficient indicate a tendency of one variable to increase or decrease together with another variable. Negative values of correlation and coefficient indicate a tendency that the increase of values of one variable is associated with the decrease of values of the other variable and vice versa. Values of correlation coefficient close to zero indicate a low association between variables, and those close to -1 or $+1$ indicate a strong linear association between two variables. The square of the correlation and coefficient is the coefficient of determination, which gives the proportion of the variation in one variable that can be explained from the variation of the other variable [2].

Next paragraph of this chapter depicts month wise correlations between actual and predicted values of Payroll cost.

Correlations			
		Actual	Predicted
Actual	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	12	
Predicted	Pearson Correlation	.799**	1
	Sig. (2-tailed)	.000	
	N	12	12
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 6-3Correlations

Above table depicts the direction and strength between actual data and predicted data. It was found that there exists a positive high correlation between them to an extent of 79.9% (.799**). The relationship is significant at 1% level of significance for two tailed test.

To elaborate above result in deep, a regression analysis was also performed. Simply regression analysis and Regression analysis are used in statistics to find trends in data. It is a statistical technique to fit a straight line through the data points. It models the quantitative relationship between two variables. It is simple because only one predictor variable is involved. It describes how one variable changes according to the change of another variable. Both variables need to be continuous. There are other types of regression to model discrete data [1].

		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	R ²
		Std. Error	Std. Error				
1	Predicted	1.520	.158		1.34	.000	
	Actual	.487	.161	.799	4.21	.000	.823

Table 6-4Regression table

The above table provides the result of constant, coefficient of determination, t-value. Coefficient is the slope of regression line and it explains that 1 unit change in independent variable will bring how much change in dependent variable. The coefficient of determination (R²) explains how much variation in the dependent variable is explained by the independent variable.

The regression results interpret the value of coefficient .799 that indicates 1% change in predicted data can result in 79.9% change in actual data. So if training is increased by 1%, this will result in 79.9% increase in performance. According to the results there is a positive relationship between actual data and predicted data.

The value of coefficient of determination (R²) is 0.823 that represents using MIS can output data that explain 82.3% correctly actual results. In other words they system accuracy for predict loan data is 82.3% accurate.

So the hypothesis H₀ (The system is accurate to forecast loan amounts.) is accepted while H₁ (The system is not accurate to forecast loan amounts) is rejecting.

7.4 Summary

Forecasted results generated by the system was compared and it is realized that the results are more than 80% accurate with actual data. Further, according to the results obtained from the test cases, most of the functions expected through the system are achieved successfully. Discussing about the success of the system, its limitations and further developments in details is included in coming chapter.

7. Conclusion & Future Developments

7.1 Introduction

This chapter analyses the overall achievements and findings of the system developed to solve the Cost Estimation problem of SLPA Payroll and discusses the further modifications that can be done to the system after evaluating the final product.

7.2 Conclusion

SLPA have very complicated, procedural and unique way for payroll calculations, estimations and HR functions. It is the key challenge for customizing tailor made software package according to SLPA requirements. Not only software packages, past research papers also not suit for fulfil SLPA requirements. Because of that most efficient way of giving solution for this case is do a thorough analysis of current procedures and make a flexible, user friendly and accurate in house development with high user involvement.

In an increasingly competitive international shipping industry environment, the imperative need and search for efficient, cost effective techniques, particularly through an application of computer and communication technology has dramatically intensified. Hence, the need for a computerized system that dynamically adapt to changing environment is apparent as there is a limited number human involvement and need to ensure about high accurate output.

To achieve the required accuracy, the system was developed to overcome the realistic cost estimation problem in SLPA Payroll. Since 2006 SLPA survived with in-house build Payroll system with smooth functioning without any issue. SLPA top management and Finance division officials are fully satisfied with on-going system and they need only minor modifications for current system.

According to the evaluation of the system, all the modules of the system are successfully implemented. At this phase of development, the functionality of generating graphical and figured outputs are fully tested with passed data. In the current manual process practiced by the finance division decision makers, they analyse past month cost

and last year particular month cost and get a rough estimate fund reservation for next payroll. Some months this estimation is way beyond with the actual cost of the particular moth. If the actual cost is very high, management has to withdraw some deposits or delay other payments. Accordingly, it is obvious that system is a fine solution to the accurate cost estimation problem for Sri Lanka Ports Authority faced for several years.

7.3 Further work

Although the System predicts the Payroll cost for on-going system, SLPA need Payroll cost estimation before Salary revision and when new employees recruits to the organization. Some salary increases are effect from back date period. It is very complicated to calculate because of OT, EPF costs have to consider for full estimation and it is expected to be added to the system through further developments.

7.4 Summary

In conclusion, developed Payroll cost estimation application added to SLPA payroll system is an acceptable solution for the time been. It helps to get ready in advance for unexpected cost hikes in some months of payroll. Outputs are very realistic and much closed for actual figures when it applied on past data. Fully customized cost estimation module must add further developments of the project. References, abbreviations and the appendixes can be found in the next sections.

Reference

- [1] A. Alexander, "Beyond payroll.," *Account. Today*, vol. 26, no. 10, pp. 48–54, 2012.
- [2] P. Iancu et al., "EMSYS - Human Resources and Payroll Management Integrated Information System," in *PRES 2012: 15TH INTERNATIONAL CONFERENCE ON PROCESS INTEGRATION, MODELLING AND OPTIMISATION FOR ENERGY SAVING AND POLLUTION REDUCTION*, 2012, vol. 29, pp. 1633–1638.
- [3] E. Saez, M. Matsaganis, and P. Tsakloglou, "Earnings determination and taxes: Evidence from a cohort-based payroll tax reform in Greece," *Q. J. Econ.*, vol. 127, no. 1, pp. 493–533, 2012.
- [4] Parimalendu, J. Chowdhury, and G. Hazra, "Integration of Human Resource Information System to DSS , CMS and other applications to increase productivity," *Counc. Innov. Res. Int. J. Comput. Technol.*, vol. 3, no. 1, pp. 55–59, 2012.
- [5] K. Vikas, "Human Resource Information System: An overview," *Anusandhanika*, vol. 4, no. 2, pp. 80–83, 2012.
- [6] S. Shiri, "Effectiveness of Human Resource Information System on HR Functions of the Organization: A Cross Sectional Study," *US-China Educ. Rev.*, vol. 9, pp. 830–839, 2012.
- [7] A. Bas, "Strategic HR Management: Strategy Facilitation Process by HR," *Procedia - Soc. Behav. Sci.*, vol. 58, pp. 313–321, 2012.
- [8] Yang AgitaRindri, RidiFerdiana, Rudy Hartanto: "Developer Payroll Approaches for Startup Environment Based on Agile Project Management ". pp. 83-121, 140-149, 2014.
- [9] [JelaAbasova](#) ; [Jan Janosik](#) ; [Veronika Simoncicova](#), [PavolTanuska](#) : "Proposal of Effective Preprocessing Techniques of Financial Data". pp. 98-104, 2017
- [10] [Kurt Newman](#), [Debashis Ghosh](#), [Robert Wohlers](#) : "Method and System for Take Home Pay Prediction and Indexing", pp. 233-237, 330-341, 2016
- [11] [Shraddha Dwivedi](#) : [ParidhiKasliwal](#) ; [SuryakantSoni](#) : "Comprehensive study of data analytics tools", pp. 189-220, 2017

- [12] Lei Zhuang ; Jiantian Zheng : “Design and Implementation of Accurate Payroll Retroactive Accounting Based on SAP Payroll Architecture”. pp. 331-346, 2015
- [13] A. Jovic ; K. Brkic ; N. Bogunovic : “An overview of free software tools for general data mining”. pp. 203-230, 2016
- [14] Anna Lisa Gentile, Sabrina Kirstein, Heiko Paulheim, Christian Bizer : “Extending RapidMiner with Data Search and Integration Capabilities“. pp. 148-156, 231-238, 2015
- [15] Marcin Blachnik, Mirosław Kordos:” Information Selection and Data Compression RapidMiner Library”. pp. 168-177, 211-219, 336-345, 2014
- [16] Sri Lanka Ports Authority : “Annual Report 2018”. pp. 87-90, 2019

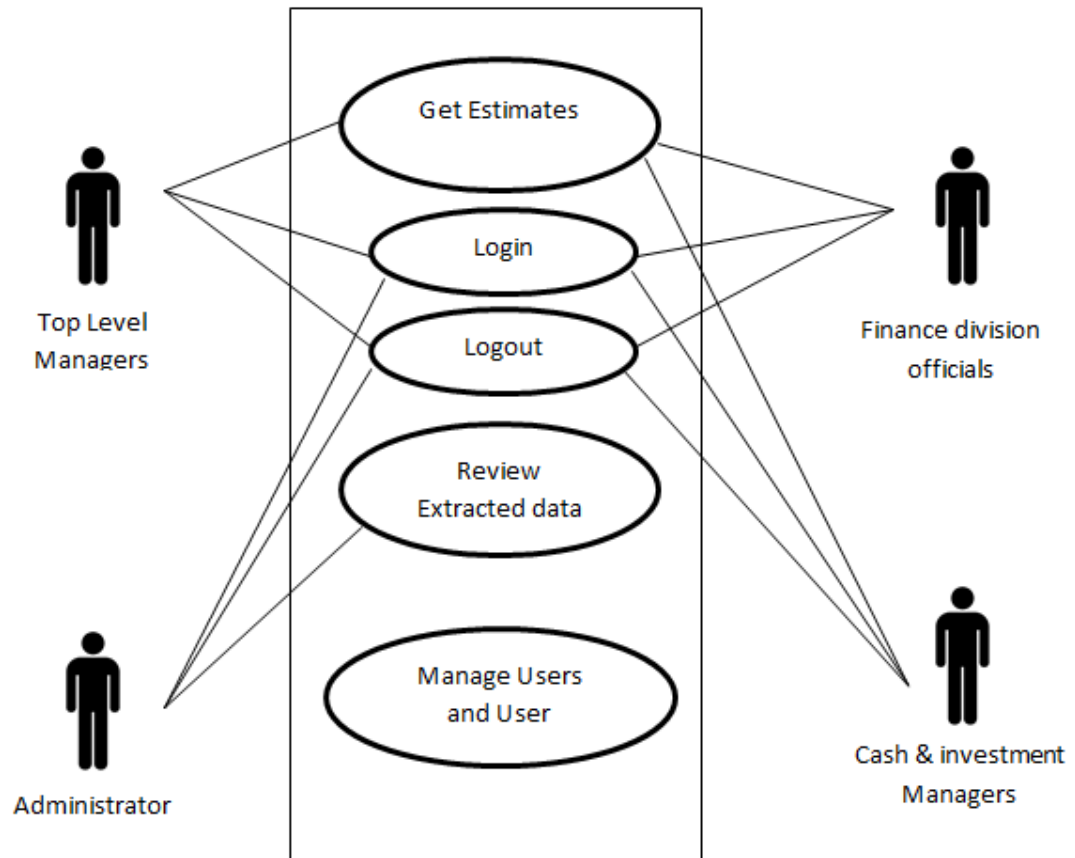
Abbreviations

SLPA	-	Sri Lanka Ports Authority
MIS	-	Management Information System
IS	-	Information Systems
EPF	-	Employee Provident Fund
ETF	-	Employee Trust Fund
OT	-	Over Time
HRIS	-	Human Resource Information System
HR	-	Human Resource
ORM	-	Object Relational Mapping
RDBMS	-	Relational Data Base Management System
MVC	-	Model View Controller
JSP	-	Java Server Pages
ASP	-	Active Server Pages
PHP	-	Personnel Home Page
AJAX	-	Asynchronous JavaScript and XML
UNIX	-	Uniplexed Information and Computer Systems
IT	-	Information Technology
SQL	-	Structured Query Language
RAM	-	Radom Access Memory
HDD	-	Hard Disk Drive
Gb	-	Giga bytes

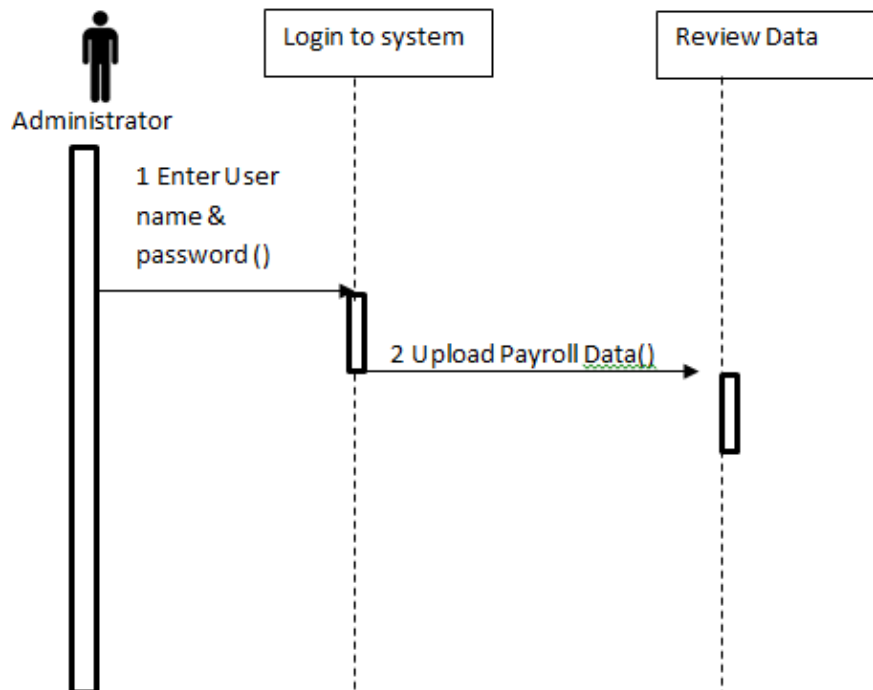
Appendix

Appendix A - Web Application Development Design

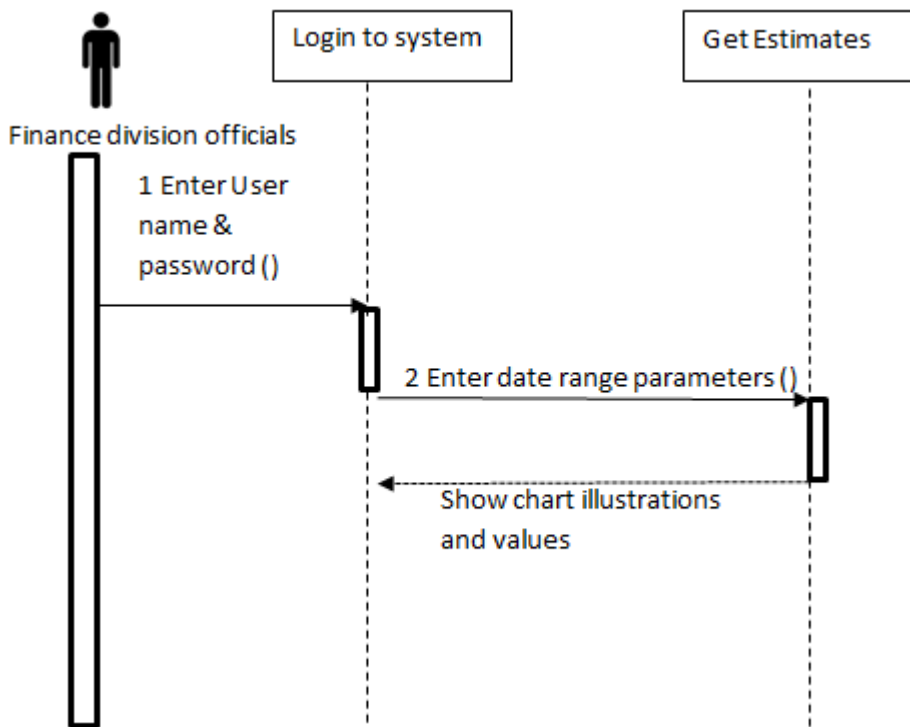
A.1 Use Case Diagram



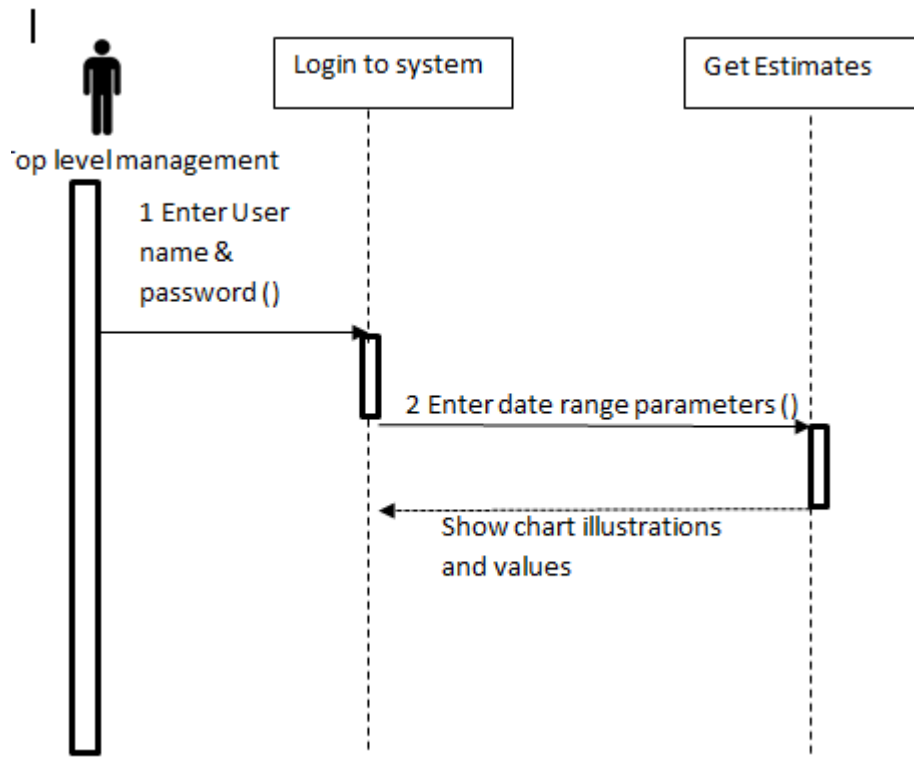
A.2.1 Sequence Diagram- Data extracting module



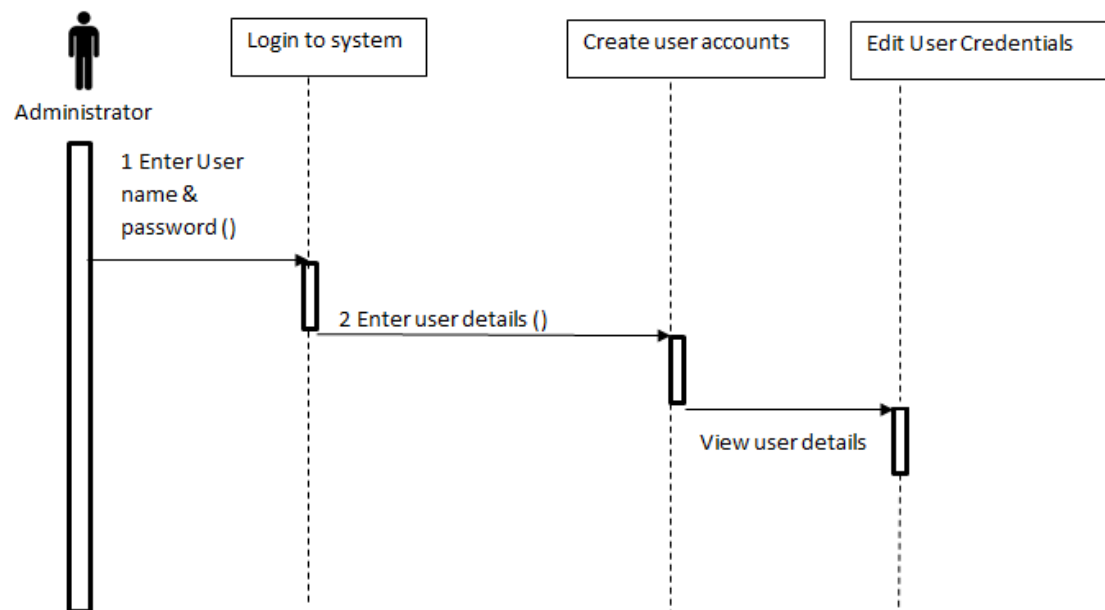
A.2.2. Sequence Diagram - Finance Division module



A.2.3. Sequence Diagram - Top Level Management Module



A.2.4 Sequence Diagram - Administrator Module



Appendix B – Code

B.1 Code 1 –

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using System.Data.OleDb;
using System.Configuration;

namespace WindowsFormsApplication1
{
    public partial class Form2 : Form
    {
        public Form2()
        {
            InitializeComponent();

            private void button1_Click(object sender, EventArgs e)
            {
                string _year = comboBox1.Text != null && comboBox1.Text != "" ?
                    comboBox1.Text : "";
                string _connString = GetConnectionStringByName("Payroll");
                double _all01 = textBox1.Text != null && textBox1.Text != "" ?
                    double.Parse(textBox1.Text.ToString()) : 0;
                double _all02 = textBox2.Text != null && textBox2.Text != "" ?
                    double.Parse(textBox2.Text.ToString()) : 0;
                double _all03 = textBox3.Text != null && textBox3.Text != "" ?
                    double.Parse(textBox3.Text.ToString()) : 0;
                double _sumAllowance = _all01 + _all02 + _all03;
                double _loanAmt = 0;
                int _index = 0;

                for ( int _month =1; _month <= 12; _month++)
                {
                    _loanAmt = 0;
                    int _day = 1;
                    string _date = _year + "-" + _month.ToString() + "-" +
                        _day.ToString();
                    StringBuilder _sbSql = new StringBuilder();

                    _sbSql.Append(" SELECT COUNT( HPEMAS1.MEMPNO) AS EMPCOUNT,0 AS
                        AMT10,SUM(HPEMAS1.MSTEP) AS AMT3");
```

```

        _sbSql.Append(" FROM HPEMAS1");
        _sbSql.Append(" WHERE DateAdd('yyyy',3, [Enter the date:]) <=
HPEMAS1.DOR ");
        _sbSql.Append(" AND DateAdd('yyyy',-1,[Enter the date:]) <=
[DOAP] ");
        _sbSql.Append(" AND HPEMAS1.MPACTIVE='A'");
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT COUNT( HPEMAS1.MEMPNO) AS
EMPCOUNT,SUM(HPEMAS1.MSTEP) AS AMT10, 0 AS AMT3 ");
        _sbSql.Append(" FROM HPEMAS1");
        _sbSql.Append(" WHERE DateAdd('yyyy',5,[Enter the date:]) <=
HPEMAS1.DOR");
        _sbSql.Append(" AND DateAdd('yyyy',-3,[Enter the date:]) >=
[DOAP]");
        _sbSql.Append(" AND HPEMAS1.MPACTIVE='A'");

        using (OleDbConnection conn = new OleDbConnection(_connString))
        {
            using (OleDbCommand cmd = new
OleDbCommand(_sbSql.ToString(), conn))
            {
                cmd.CommandType = CommandType.Text;
                cmd.Parameters.AddWithValue("_date", _date);
                //cmd.Parameters.AddWithValue("LastName",
txtLastName.Text);
                conn.Open();

                using (OleDbDataReader reader = cmd.ExecuteReader())
                {
                    while (reader.Read())
                    {
                        string _lableID = "lb1";
                        string _setLabelID = "";

                        if (reader["AMT3"].ToString() != "0.00" &&
reader["AMT3"].ToString() != "")
                        {
                            _loanAmt = _sumAllowance * 3 *
int.Parse(reader["EMPCOUNT"].ToString());
                            _loanAmt = _loanAmt +
double.Parse(reader["AMT3"].ToString());
                            _setLabelID = "";
                            _index = _index + 1;
                            _setLabelID = _lableID + _index.ToString();
                            this.Controls.Find(_setLabelID,
true)[0].Text = reader["EMPCOUNT"].ToString();
                            _setLabelID = "";
                            _index = _index + 1;
                            _setLabelID = _lableID + _index.ToString() ;
                            this.Controls.Find(_setLabelID,
true)[0].Text = string.Format("{0:#,##0.00}", _loanAmt);
                        }
                        if (reader["AMT10"].ToString() != "0.00" &&
reader["AMT10"].ToString() != "")
                        {
                            _loanAmt = _sumAllowance * 10 *
int.Parse(reader["EMPCOUNT"].ToString());
                            _loanAmt = _loanAmt +
double.Parse(reader["AMT10"].ToString());
                            _setLabelID = "";

```

```

        _index = _index + 1;
        _setLabelID = _lableID + _index.ToString();
        this.Controls.Find(_setLabelID,
true)[0].Text = reader["EMPCOUNT"].ToString();
        _setLabelID = "";
        _index = _index + 1;
        _setLabelID = _lableID + _index.ToString();
        this.Controls.Find(_setLabelID,
true)[0].Text = string.Format("{0:##0.00}", _loanAmt);
    }
}
}
}
}
}

static string GetConnectionStringByName(string Payroll)
{
    // Assume failure.
    string returnValue = null;

    // Look for the name in the connectionStrings section.
    ConnectionStringSettings settings =
        ConfigurationManager.ConnectionStrings[Payroll];

    // If found, return the connection string.
    if (settings != null)
        returnValue = settings.ConnectionString;

    return returnValue;
}

private void textBox1_KeyPress(object sender, KeyPressEventArgs e)
{
    if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
        (e.KeyChar != '.'))
    {
        e.Handled = true;
    }

    // only allow one decimal point
    if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
1))
    {
        e.Handled = true;
    }
}

private void textBox3_KeyPress(object sender, KeyPressEventArgs e)
{
    if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
        (e.KeyChar != '.'))
    {
        e.Handled = true;
    }

    // only allow one decimal point
    if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
1))
    {
        e.Handled = true;
    }
}

```

```

    }

    private void textBox2_KeyPress(object sender, KeyPressEventArgs e)
    {
        if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
            (e.KeyChar != '.'))
        {
            e.Handled = true;
        }

        // only allow one decimal point
        if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
1))
        {
            e.Handled = true;
        }
    }
}

```

B.2 Code 2 –

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using System.Data.OleDb;
using System.Configuration;

namespace WindowsFormsApplication1
{
    public partial class Form1 : Form
    {
        public Form1()
        {
            InitializeComponent();

            private void label3_Click(object sender, EventArgs e)
            {

            }

            private void button1_Click(object sender, EventArgs e)
            {
                string _date = dateTimePicker1.Value.ToShortDateString();
                string _connString = GetConnectionStringByName("Payroll");
                double _all01 = textBox1.Text != null && textBox1.Text != "" ?
                    double.Parse(textBox1.Text.ToString()) : 0;
                double _all02 = textBox2.Text != null && textBox2.Text != "" ?
                    double.Parse(textBox2.Text.ToString()) : 0;
                double _all03 = textBox3.Text != null && textBox3.Text != "" ?
                    double.Parse(textBox3.Text.ToString()) : 0;
                double _sumAllowance = _all01 + _all02 + _all03;
                double _loanAmt = 0;
                StringBuilder _sbSql = new StringBuilder();
                _sbSql.Append("SELECT COUNT( HPEMAS1.MEMPNO) AS EMPCOUNT,SUM(HPEMAS1.MSTEP) AS AMT10, 0 AS AMT3 ");
                _sbSql.Append(" FROM HPEMAS1");
                _sbSql.Append(" WHERE DateAdd('yyyy',5,[Enter the date:]) <= HPEMAS1.DOR");
                _sbSql.Append(" AND DateAdd('yyyy',-3,[Enter the date:]) >= [DOAP]");
                _sbSql.Append(" AND HPEMAS1.MPACTIVE='A'");
                _sbSql.Append(" UNION ALL ");
                _sbSql.Append(" SELECT COUNT( HPEMAS1.MEMPNO) AS EMPCOUNT,0 AS AMT10,SUM(HPEMAS1.MSTEP) AS AMT3");
                _sbSql.Append(" FROM HPEMAS1");
                _sbSql.Append(" WHERE DateAdd('yyyy',3, [Enter the date:]) <= HPEMAS1.DOR ");
                _sbSql.Append(" AND DateAdd('yyyy',-1,[Enter the date:]) <= [DOAP]");
                _sbSql.Append(" AND HPEMAS1.MPACTIVE='A'");
            }
        }
    }
}
```

```

using (OleDbConnection conn = new OleDbConnection(_connString))
{
    using (OleDbCommand cmd = new OleDbCommand(_sbSql.ToString(),
        conn))
    {
        cmd.CommandType = CommandType.Text;
        cmd.Parameters.AddWithValue("_date", _date);
        conn.Open();

        using (OleDbDataReader reader = cmd.ExecuteReader())
        {
            while (reader.Read())
            {
                if (reader["AMT10"].ToString() != "0.00" &&
                    reader["AMT10"].ToString() != "")
                {
                    _loanAmt = _sumAllowance * 10 *
                        int.Parse(reader["EMPCOUNT"].ToString());
                    _loanAmt = _loanAmt +
                        double.Parse(reader["AMT10"].ToString());
                    lbl10Count.Text = reader["EMPCOUNT"].ToString();
                    lbl10LoanAmt.Text =
                        string.Format("{0:#,##0.00}", _loanAmt);
                }
                if (reader["AMT3"].ToString() != "0.00" &&
                    reader["AMT3"].ToString() != "")
                {
                    _loanAmt = _sumAllowance * 3 *
                        int.Parse(reader["EMPCOUNT"].ToString());
                    _loanAmt = _loanAmt +
                        double.Parse(reader["AMT3"].ToString());
                    lbl3Count.Text = reader["EMPCOUNT"].ToString();
                    lbl3LoanAmt.Text = string.Format("{0:#,##0.00}",
                        _loanAmt);
                }
            }
        }
    }
}

```

```

static string GetConnectionStringByName(string Payroll)
{
    // Assume failure.
    string returnValue = null;

    // Look for the name in the connectionStrings section.
    ConnectionStringSettings settings =
        ConfigurationManager.ConnectionStrings[Payroll];

    // If found, return the connection string.
    if (settings != null)
        returnValue = settings.ConnectionString;

    return returnValue;
}

```

```

private void textBox1_KeyPress(object sender, KeyPressEventArgs e)
{
    if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
        (e.KeyChar != '.'))
    {
        e.Handled = true;
    }

    // only allow one decimal point
    if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
                                1))
    {
        e.Handled = true;
    }
}

private void textBox3_KeyPress(object sender, KeyPressEventArgs e)
{
    if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
        (e.KeyChar != '.'))
    {
        e.Handled = true;
    }

    // only allow one decimal point
    if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
                                1))
    {
        e.Handled = true;
    }
}

private void textBox2_KeyPress(object sender, KeyPressEventArgs e)
{
    if (!char.IsControl(e.KeyChar) && !char.IsDigit(e.KeyChar) &&
        (e.KeyChar != '.'))
    {
        e.Handled = true;
    }

    // only allow one decimal point
    if ((e.KeyChar == '.') && ((sender as TextBox).Text.IndexOf('.') > -
                                1))
    {
        e.Handled = true;
    }
}
}

```

B.3 Code 3

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Configuration;
using System.Data;
using System.Windows.Forms;
using System.Data.OleDb;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace WindowsFormsApplication1
{
    public partial class Form4 : Form
    {
        public Form4()
        {
            InitializeComponent();

            private void Form4_Load(object sender, EventArgs e)
            {

            }

            private void table2BindingSource_CurrentChanged(object sender, EventArgs
e)
            {

            }

            private void button1_Click(object sender, EventArgs e)
            {
                DataTable _tb = new DataTable("PAYROLL");
                string _fromYear = cmYear.Text != null && cmYear.Text != "" ?
cmYear.Text : "";
```



```

        string _toYear = comboBox2.Text != null && comboBox2.Text != "" ?
comboBox2.Text : "";

        string _fromMonth = cmMonth.Text != null && cmMonth.Text != "" ?
cmMonth.Text : "";

        string _toMonth = comboBox1.Text != null && comboBox1.Text != "" ?
comboBox1.Text : "";

        string _payCode = cmPayCode.Text != null && cmPayCode.Text != "" ?
cmPayCode.Text : "";

        string [] _payCodes ;
        _payCodes = _payCode.Split('-');
        _payCode = _payCodes[0].ToString().Trim();

        string _connString = GetConnectionStringByName("Payroll");
        //OleDbConnection _con = new OleDbConnection(_connString);

        StringBuilder _sbSql = new StringBuilder();
        //get all data together
        _sbSql.Append(" SELECT month1, SUM(amount1) as amount1,
SUM(amount2) as amount2 ");
        _sbSql.Append(" FROM (");
        //get table1 data
        _sbSql.Append(" SELECT year & '-' & month as month1, amount as
amount1, 0 as amount2 ");
        _sbSql.Append(" FROM table1");
        _sbSql.Append(" WHERE (year = " + _fromYear + " AND month >= " +
_fromMonth + " AND month <= 12 )");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT year & '-' & month as month1, amount as
amount1, 0 as amount2 ");
        _sbSql.Append(" FROM table1");
        _sbSql.Append(" WHERE (year > " + _fromYear + " AND year < " +
_toYear + ")");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT year & '-' & month as month1, amount as
amount1, 0 as amount2 ");
        _sbSql.Append(" FROM table1");
        _sbSql.Append(" WHERE (year = " + _toYear + " AND month >= 1 AND
month <= " + _toMonth + ")");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        //get table2 data
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT year & '-' & month as month1,0 as amount1
,amount as amount2 ");
        _sbSql.Append(" FROM table2");

```

```

        _sbSql.Append(" WHERE (year = " + _fromYear + " AND month >= " +
        _fromMonth + " AND month <= 12 )");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT year & '-' & month as month1,0 as amount1
        ,amount as amount2 ");
        _sbSql.Append(" FROM table2");
        _sbSql.Append(" WHERE (year > " + _fromYear + " AND year < " +
        _toYear + ")");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        _sbSql.Append(" UNION ALL ");
        _sbSql.Append(" SELECT year & '-' & month as month1,0 as amount1
        ,amount as amount2 ");
        _sbSql.Append(" FROM table2");
        _sbSql.Append(" WHERE (year = " + _toYear + " AND month >= 1 AND
        month <= " + _toMonth + ")");
        _sbSql.Append(" AND paycode='" + _payCode + "'");
        _sbSql.Append(" group by month1");

        using (OleDbConnection conn = new OleDbConnection(_connString))
        {
            using (OleDbCommand cmd = new
            OleDbCommand(_sbSql.ToString(), conn))
            {
                cmd.CommandType = CommandType.Text;
                conn.Open();
                using (OleDbDataReader reader = cmd.ExecuteReader())
                    _tb.Load(reader);

                if (_tb.Rows.Count > 0)
                {
                    chart1.DataSource = _tb;
                    chart1.Series[0].XValueMember = "month1";
                    chart1.Series[0].YValueMembers = "amount1";
                    chart1.Series[1].XValueMember = "month1";
                    chart1.Series[1].YValueMembers = "amount2";
                    chart1.DataBind();
                }
            }
        }
    }
}

```

```

    }

    static string GetConnectionStringByName(string Payroll)
    {
        // Assume failure.
        string returnValue = null;

        // Look for the name in the connectionStrings section.
       ConnectionStringSettings settings =
            ConfigurationManager.ConnectionStrings[Payroll];

        // If found, return the connection string.
        if (settings != null)
            returnValue = settings.ConnectionString;

        return returnValue;
    }

    private void chart1_Click(object sender, EventArgs e)
    {
    }
}
}

```

B.4 Code 3

File Edit Process View Connections Settings Extensions Help

Views: Design Results Turbo Prep Auto Model Deployments Find data, operators...etc All Studio

Result History ExampleSet (Generate Attributes)

Open in Turbo Prep Auto Model Filter (1,009 / 1,009 examples): all

Row No.	MONTH	PAYCODE	sum(AMOU...	2019 predict...
1	1	5	481709038	457623586.1...
2	1	8	295331419.5...	280564848.5...
3	1	9	4642895	4410750.250
4	1	10	31983759.380	30384571.411
5	1	15	453174909.6...	430516164.1...
6	1	23	149730.760	142244.222
7	1	24	2888000	2743600
8	1	25	121260	115197
9	1	26	2970000	2821500
10	1	28	226669	215335.550
11	1	30	25767572	24479193.400
12	1	31	6348	6030.600
13	1	41	783852.420	744659.799
14	1	55	4208838.140	3998396.233
15	1	56	5585	5305.750
16	1	58	3133734.770	2977048.032
17	1	59	684168.740	649960.303
18	1	60	151553.870	143976.177
19	1	61	37086.160	35231.852
20	1	75	143929.570	136733.092
21	1	80	7328.750	6962.312
22	1	81	2641031.140	2508979.583
23	1	87	28480750	27056712.500

ExampleSet (1,009 examples, 0 special attributes, 4 regular attributes)

Repository

- Import Data
- Training Resources (connected)
- Samples
- Community Samples (connected)
- Local Repository (Local)
 - Connections
 - data
 - processes
 - Join date wise analysis (9/3/20)
 - Latest (9/7/20 7:04 PM - 0 KB)
 - My Prediction Model (9/3/20)
- DB (Legacy)

